



Quantum & Optronics areas

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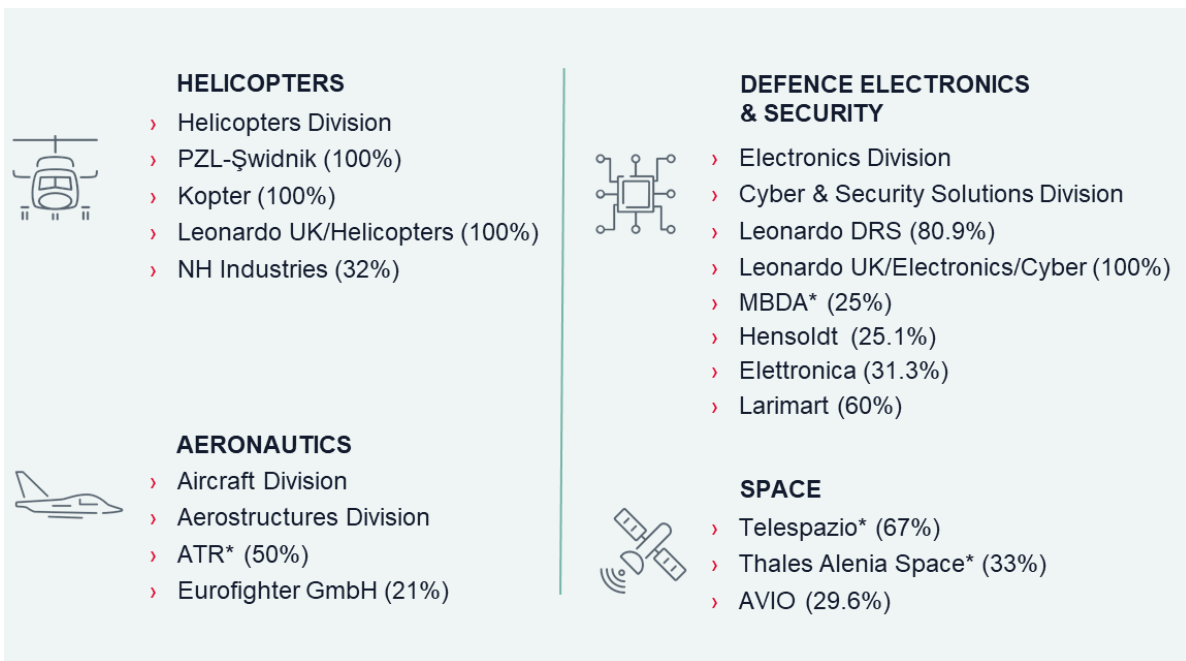




A GLOBAL PLAYER IN AEROSPACE, DEFENCE AND SECURITY

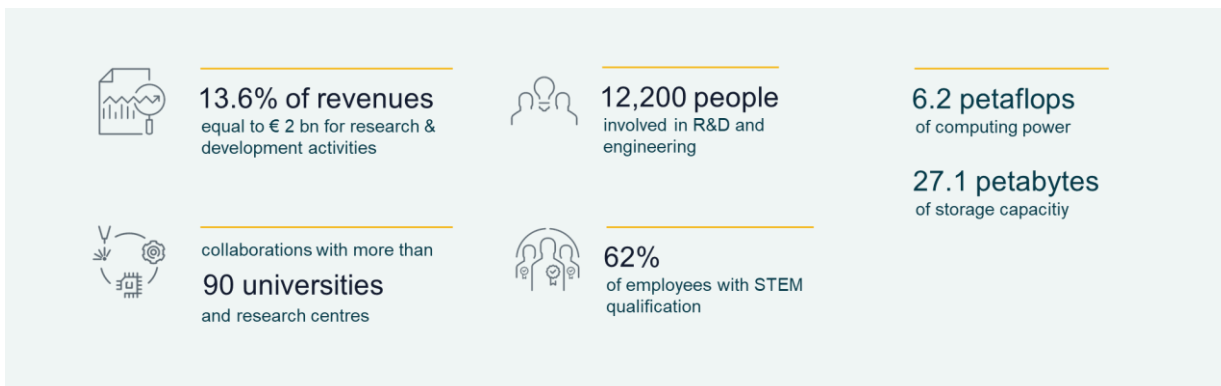
 **LEONARDO** is a global company that develops **multi-domain operational capabilities** in the Aerospace, Defence and Security sector, with an integrated offer of high-technology solutions for military and civil applications.

BUSINESS SECTORS



* Joint venture | % Leonardo's share

TECHNOLOGICAL INNOVATION



*As of 2022

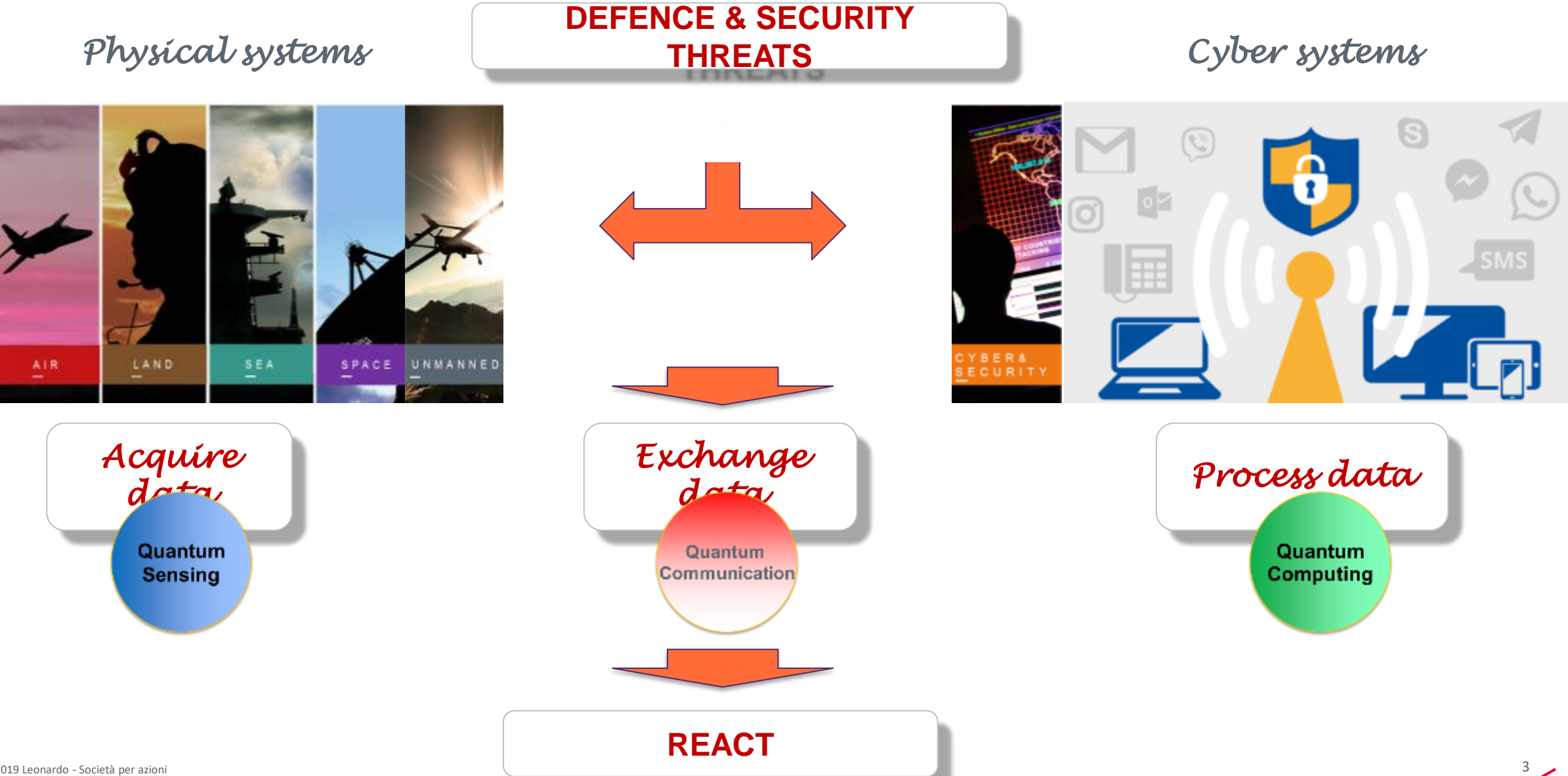
INTERNATIONAL FOOTPRINT



*As of December 31, 2022



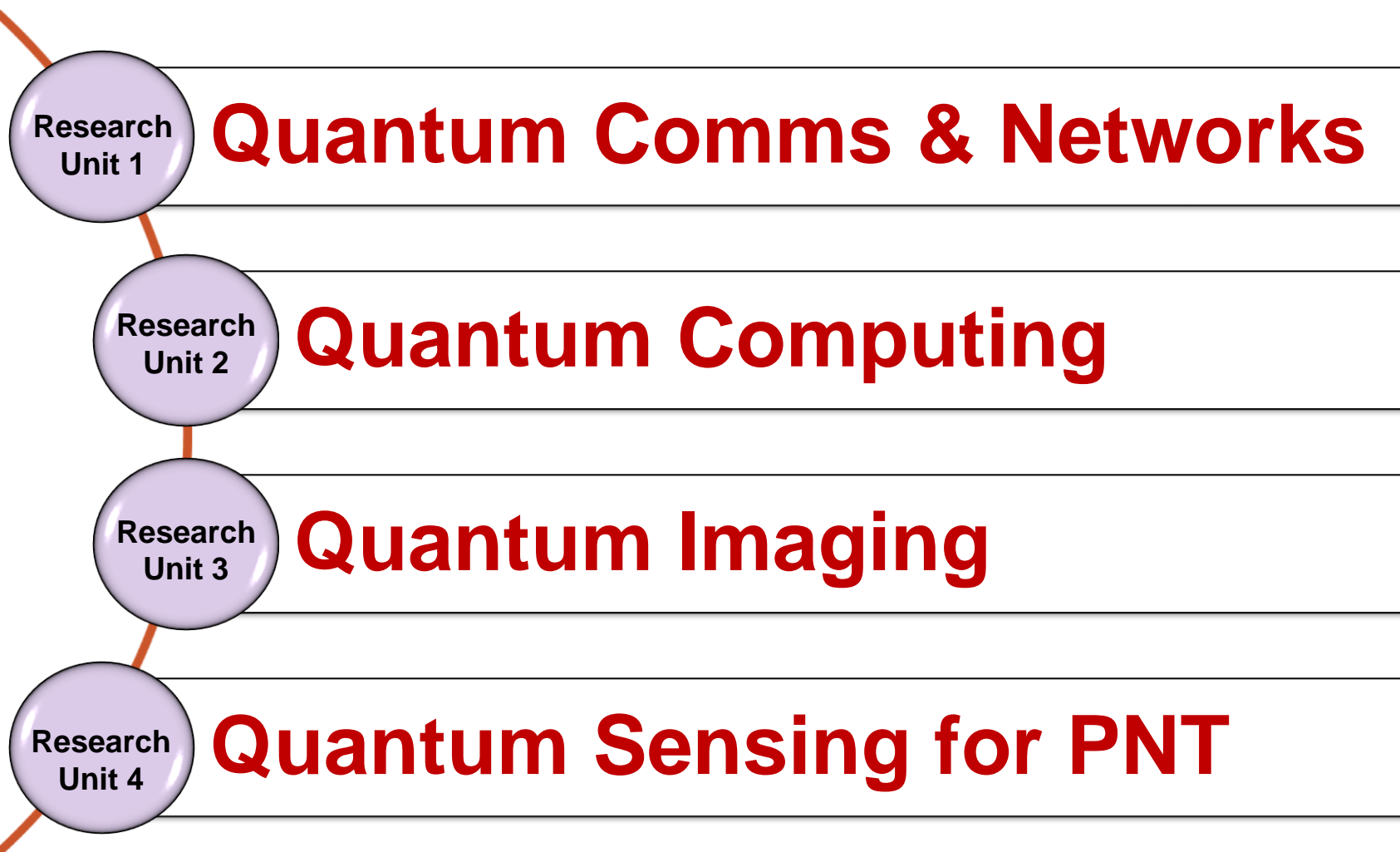
Quantum Technologies as potential enabler in the 3 pillars security process ...





Quantum Technologies Research Lab

4 Research
Units



Research Unit 1 - Quantum Comms from Building Blocks (BBs) to Networks

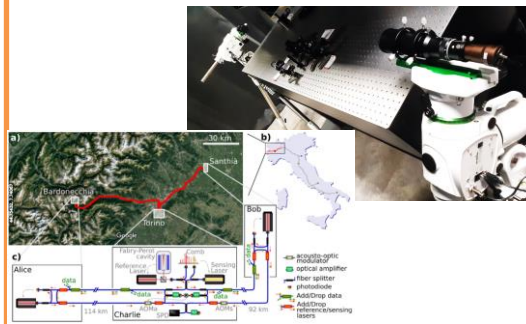
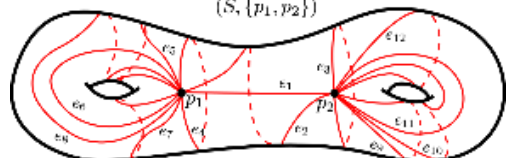


QUANTUM RANDOM NUMBER GENERATOR

- ❑ Random keys generated thanks to module already integrated
- ❑ 1st version Demo QRNG passed NIST Test Battery

POST QUANTUM CRYPTOGRAPHY

- ❑ Proprietary Asymmetric algorithm replacing RSA based on novel untractable math problems to be **resistant to a Quantum Computer attack**



Novel QKD Devices and protocols

- ❑ Free space QKD link TASI-LDO under construction
- ❑ Twin-Field protocol demonstrated on Italian backbone



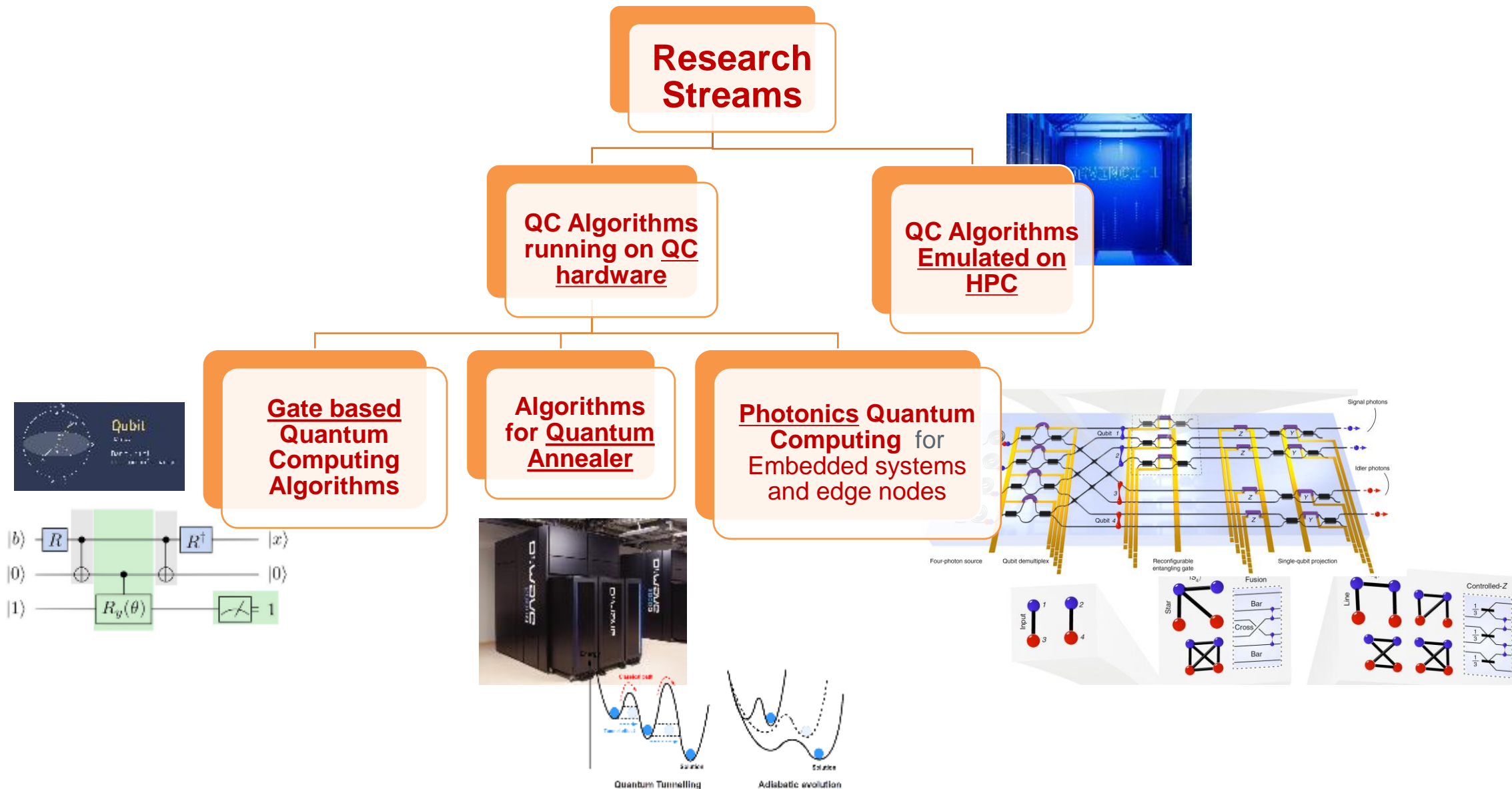
QUANTUM NETWORKS

- ❑ Demo for Full E2E QKD Network for Crypto Key exchange
- ❑ Design of Global QKD SatCOM+ Ground QUANTUM Networks
- ❑ Security Risk Assessment also addressing Quantum Vulnerabilities





Research Unit 2: Quantum Computing in Leonardo



Research Unit 2: Our research streams and challenges

MBQC theory



Simulation of MBQC algos on HPC

- Implementation of QAOA in paddle Quantum
- Data clustering via MAX K-CUT



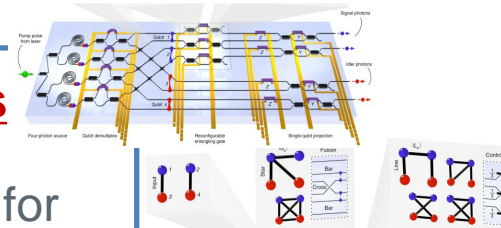
Photonic Noise simulation in MBQC

Simulation of noise of real photonic platforms in the MBQC formalism

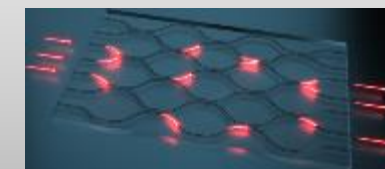


UNIVERSITÀ DEGLI STUDI DI TRIESTE

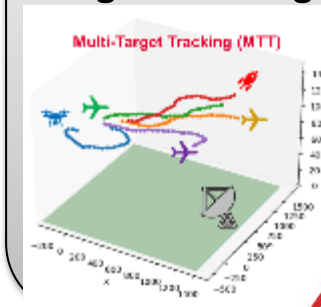
Photonics Quantum Computing for Embedded systems and edge nodes



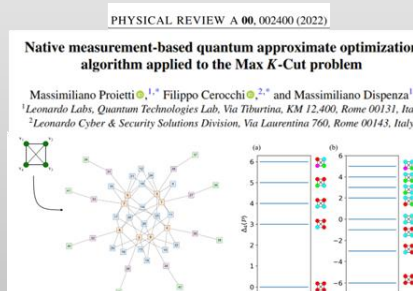
Experimental QUANTUM MACHINE LEARNING on Photonic chip



QUANTUM Speed up for RADAR Multi Target Tracking



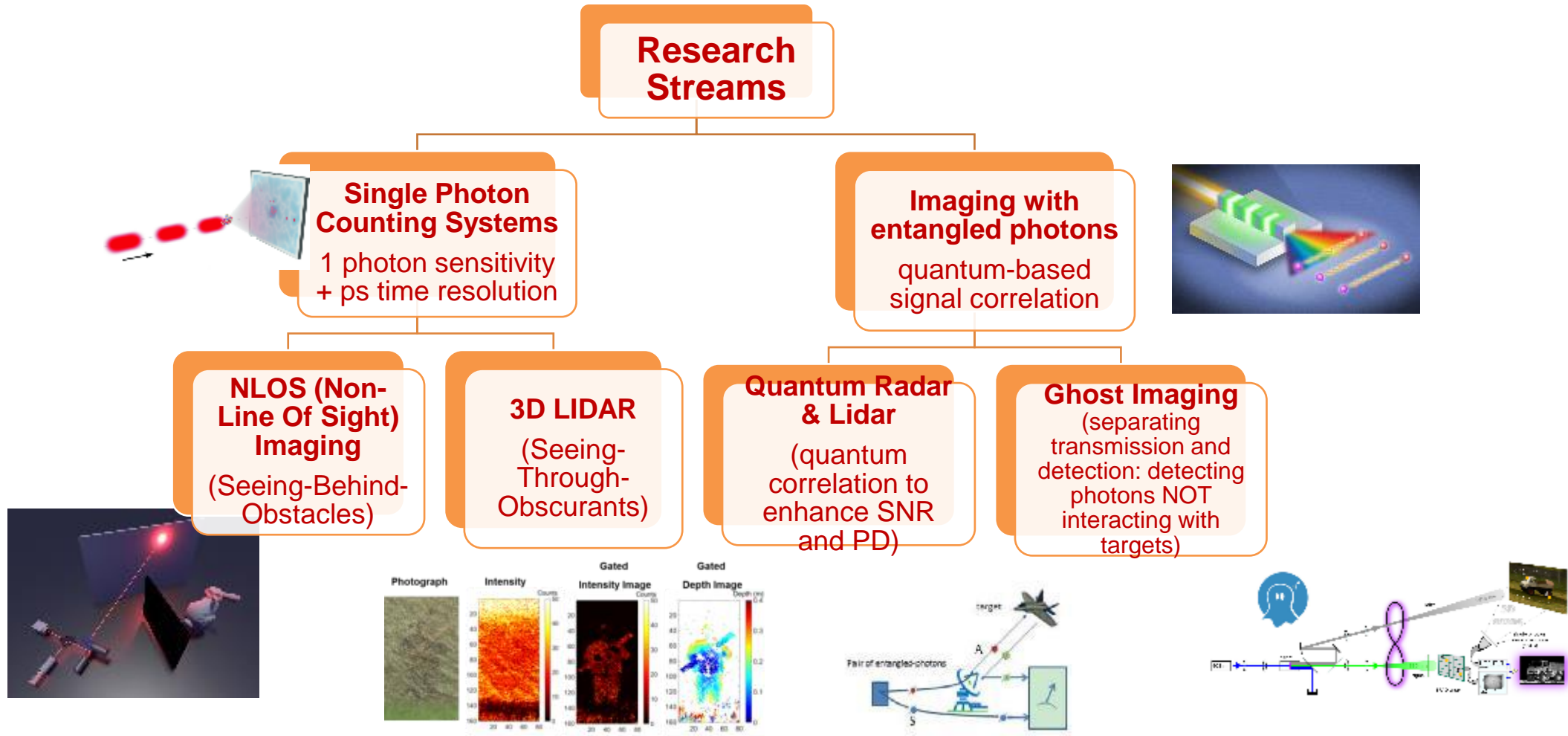
Optimisation & Data clustering Algorithm for photonic HW



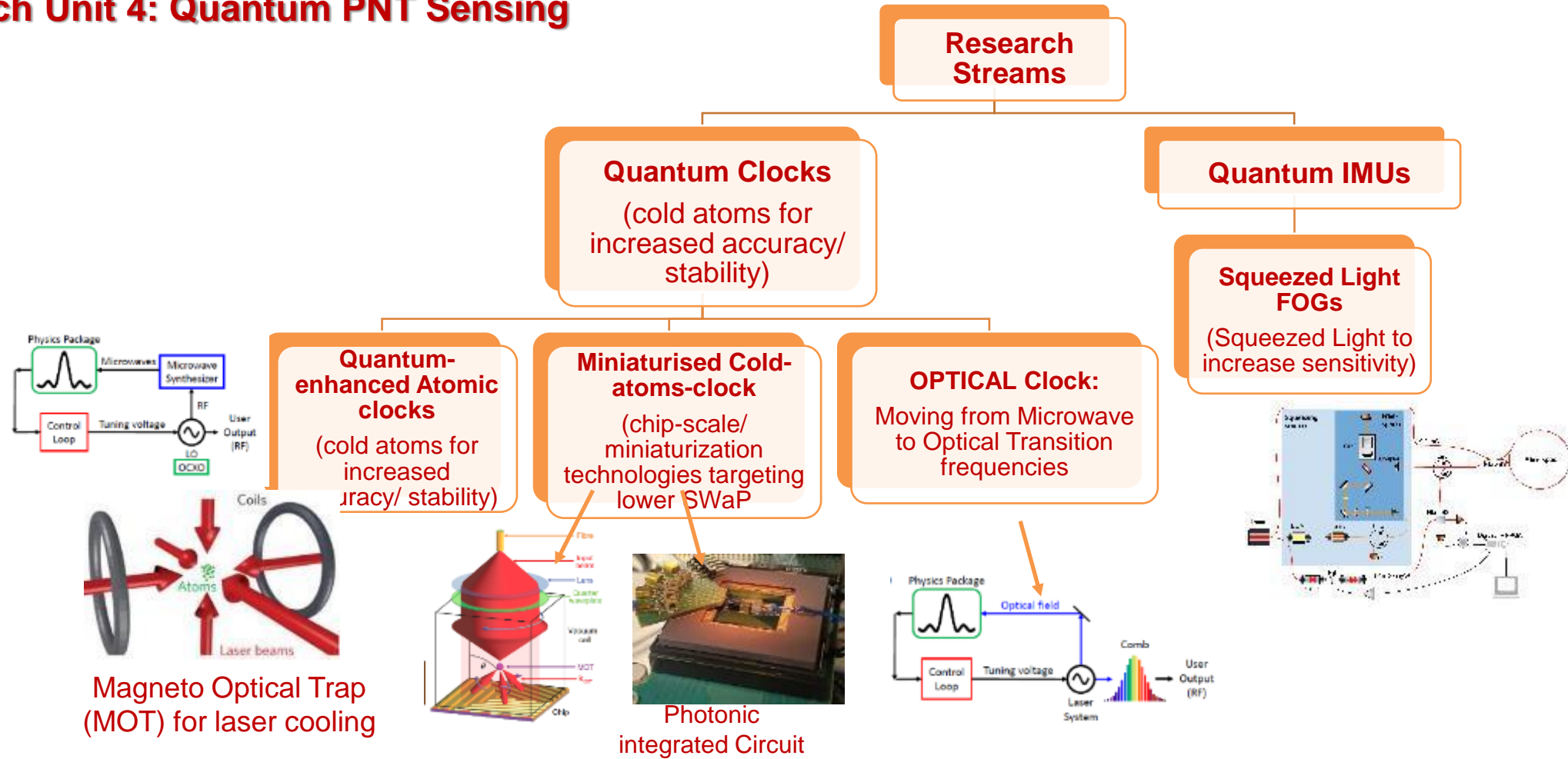
MAX-CUT solution with QAOA



Research Unit 3: Quantum Imaging



Research Unit 4: Quantum PNT Sensing



EDF Quantum Sensing: **ADEQUADE**
Topic (for LDO): Quantum Sensing for Optronics and PNT (Quantum Clocks)



EDA PADR **QUANTAQUEST**
Topic: Quantum Communication & Sensing for Defence



MoD Funded National Project
Topic (for LDO): Miniaturised Quantum Clocks for airborne
Partner (33): Leonardo, GEM-Elettronica



The Leonardo Labs – Numbers

The main Leonardo Labs numbers are:

11 Leonardo Labs (in 6 regions in Italy and 1 in the USA)

9 Research areas

38 Research units

4 Joint external laboratories

136 Research fellows at end 2022

In the support at the activities of Leonardo Labs is available the newborn **Supercomputer Davinci-1**. These are the main numbers of Davinci-1:

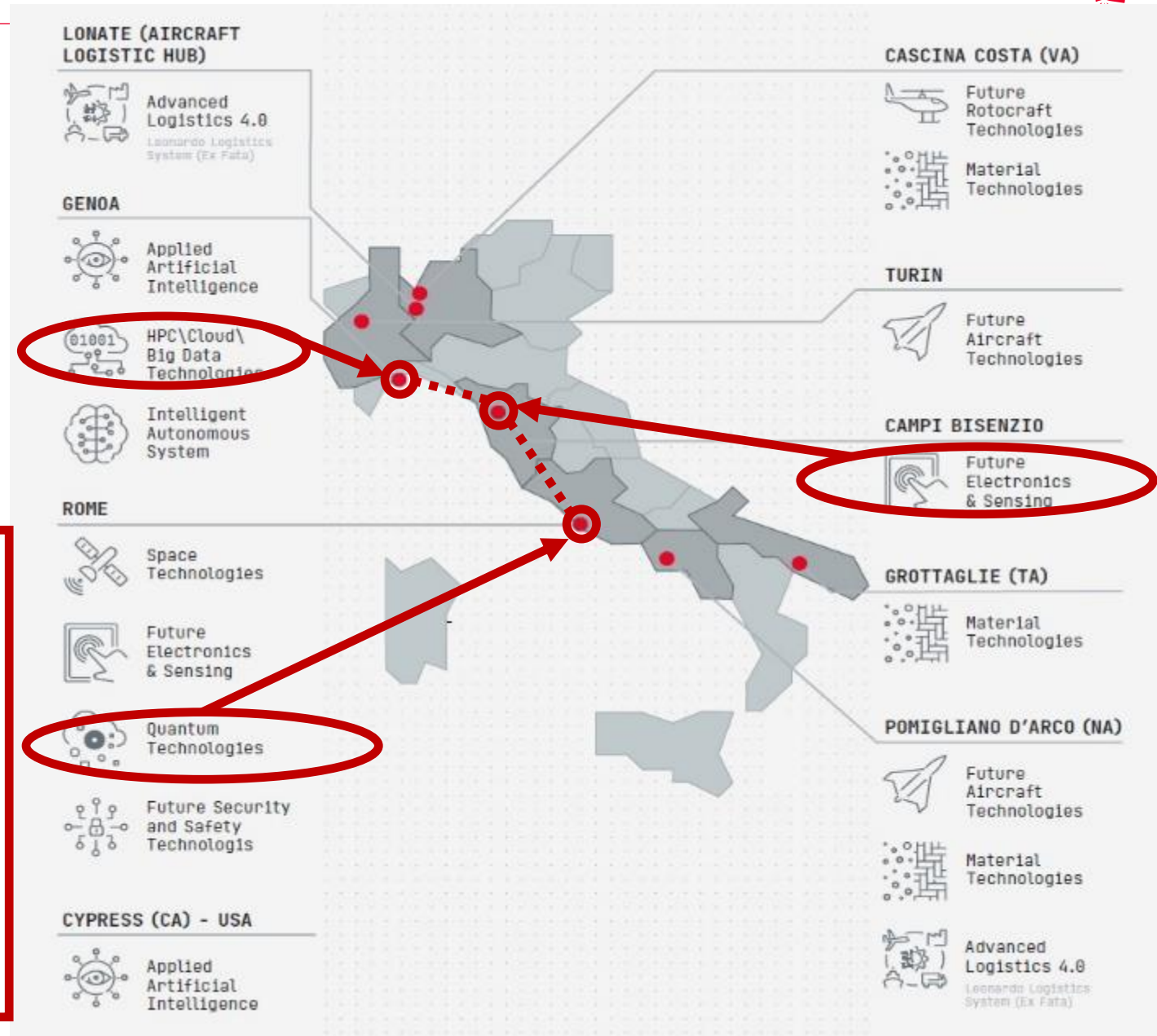
4th in the aerospace sector behind only to NASA JAXA, DLR agencies;

24th in the private company supercomputers;

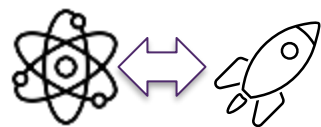
150th in the top 500 worldwide supercomputers;

5 Pflops of computing power;

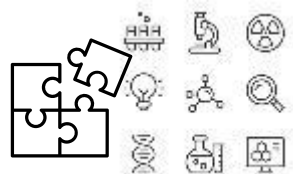
20 PByte of cumulative storage capacity.



Strategy 4 definition of Quantum Technologies Roadmap



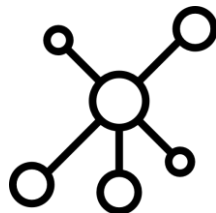
**Match: Quantum Solutions
vs
Needs from DIVISIONS**



Define: Research Streams



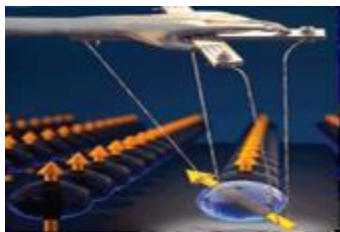
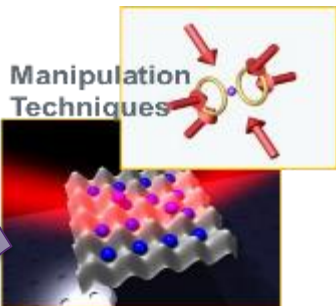
**Launch: Internal R&D
investments**



**Feed: National/
International Networking**



**Join: Cooperative National /
International Projects**



Enabling
Technologies



Products

Projects portfolio & collaborations

QUANTUM COMMS & COMPUTING



EDA PADR **QUANTAQUEST**

Topic: Quantum Communication & Sensing for Defence

Partner: Thales (FR - Leader), Leonardo, CNRS (FR), Telespazio, UniPD, CNR, Lionix BV (SME-NL), QuiX BV (SME-NL), Thales Alenia Space France (FR)



EC Project **EuroQCI GROUND SEGMENT - OQTAVO**

Topic: Terrestrial Segment per una Infrastruttura di Quantum Communication Europea

Partner: Airbus (FR - Leader), Leonardo, Telespazio, CNR (FR), INRIM, Orange (FR), PwC (FR)



ESA Project **EuroQCI SPACE SEGMENT - SAGA**

Topic: Space Segment per una Infrastruttura di Quantum Communication Europea

Partner: OHB (D), Thales Alenia Space Italia (Leader), Leonardo, Telespazio, Thales Alenia Space France, Thales Alenia Space Switzerland (CH), Fraunhofer HHI (D), ecc.



DIGITAL EUROPE: **QUID**

Topic: Deployment of Italian Quantum Comms Infrastructure

Partners: INRIM, ASI, CNR, Leonardo, Telecom, Telespazio, TAS-I, UNIRM1, UNINA, UNITS, ...



PNRM **Q4SEC**

Topic: A national Supply chain for per Quantum Communication Components and Systems

Partner: Leonardo, Telespazio, Telsy, UniPD, UNIRM1 (FISICA), INRIM, CNR



LEONARDO **Solvers Wanted Challenge**

Contract 1: **Noisy Photonic Quantum Computing**

Partner: Univ. Trieste



Projects portfolio & collaborations

QUANTUM IMAGING & PNT SENSING



EDF Quantum Sensing: **ADEQUADE**

Topic (for LDO): Quantum Sensing for Optronics and PNT (Quantum Clocks)

Partner (33): Thales (FR), Leonardo (IT), Diehl (GER), Telespazio (IT), MBDA (IT/FR), Elettronica (IT), INRIM, CNR, TNO (NL), Fraunhofer (D), etc.



EDA: Project **QUANDO**

Contract 1: Quantum Technologies for Defence in Optronics sensing

Contract 2: Quantum Technology for Defence in RF sensing

Partners: CNR, Leonardo, Thales, Onera, Hensoldt, Flyby, DLR



HORIZON EU: **MUQUABIS**

Topic: Quantum Ghost Imaging for New Vision Systems

Partner: CNR, Max-Planck Institute (GER), Leonardo (IT), Hebrew University of Jerusalem (ISR), Element6 (UK), etc.



LEONARDO **Solvers Wanted Challenge**

Contract 2: Quantum Radar / Lidar

Partner: CNIT-RASS



ITALY MoD Funded Programme

Focus Topic : Miniaturised Quantum Clocks for Airborne

Partner: Leonardo, GEM-Elettronica